Building Research Establishment Digest

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# Soakaways

*A soakaway should have sufficient storage capacity to accommodate a large amount of water from a severe, but comparatively rare, storm and should be able to disperse water at the (lower) average rate of flow into it.*

*This digest describes a simple test for the permeability of the soil in which a soakaway is to be constructed and how to convert the test results to size of soakaway for a given rate of stormwater flow. Some constructional details are included.*

*The design rules proposed are applicable to any part of the country, whatever its annual rainfall.*

A sewerage system may be 'separate' to accept foul sewage only, all surface water being discharged either to a separate surface-water sewer or direct to watercourses or soakaways; it may be 'partially separate', accepting foul sewage and some surface water with the balance discharged as above; or it may be 'combined' in which a single sewer carries the whole of the foul sewage together with all surface water from roads, footpaths, roofs and yards. Both the partially separate and combined systems will involve spasmodic rushes of storm sewage at the treatment works and this has some practical disadvantages. In general, the present tendency is to favour the adoption of the separate system, with a consequent need for soakaways in some situations.

British Standard Code of Practice CP 301:1971 *Building drainage* suggests that a common method of designing soakaways is to provide water storage capacity equal to at least 13 mm of rainfall over the impermeable area but that on some sites tests of the permeability of the soil through trial boreholes may be needed. This digest indicates a simple method of making such a test and how to interpret the results so as to design a soakaway that will accept all the rainwater from a house or similar small building.

## Rainfall

The total amount of rain which falls on a house each year varies with its position in the country, but the amount which falls during a storm of given duration is not so very different in different parts of the country and the most difficult task for a soakaway is to deal with the maximum flow during a rainstorm. The peak rate of rainfall, at the height of a storm, does not last very long, so that the longer the storm lasts the lower the average rate of rainfall is likely to be. This means that a soakaway will have to accept a certain quantity of water in a few minutes but that over several hours, or a day, the average rate of flow of water into it will be less. A successful soakaway is one with sufficient storage capacity to accept the sudden inflow of water and a sufficient rate of dissipation to deal with the average rate of flow.

On the basis of summarised rainfall data in the appropriate form, which is more or less applicable to the whole country, Fig 1 has been prepared. It is very likely that some improvement of this figure could be made for a given locality, by fuller consideration of the actual rainfall data available and applicable for that place. But it is considered that this improvement would not greatly affect the practical recommendations that are advanced here for permeability tests and soakaways.

### Dispersion

The rate at which water will disperse into the ground depends largely on the permeability of the soil and this can vary tremendously from place to place. Clays such as London Clay, Oxford Clay and Gault are almost impervious (they have been used to line canals and for water cut-offs in dams) and no soakaway formed in them would be able to disperse much water. Sands and gravels, on the other hand, can be very permeable and a soakaway will be able to disperse a great deal of water into this type of soil. The word 'soil' is used here in an engineering rather than an agricultural sense. Between these two extreme types of soil there is a whole range with varying permeabilities.

A soakaway will only be effective when it is wholly above the water table and any available information about the seasonal rise and fall of the water table should be considered in relation to the depth of the soakaway.

### Test

An indication of the permeability of a soil is given by the rate at which water will disperse into it from a shallow borehole. By using a trial borehole of the same depth as the proposed soakaway, water from it will soak into the same strata that will have to take water from the soakaway and the measured rate of percolation will be applicable.

The hole should be bored with a 150 mm diameter hand or power auger in the position proposed for the soakaway and initially taken to a depth of 1 m, corresponding to the bottom of the smallest soakaway likely to be required. To perform the test, water should be poured into the hole to a depth of 300 mm and an observation made of the time required for it to soak away. The depth of water can be gauged by marking a stick so that when it is held down the hole its end is 300 mm above the bottom of the hole. If the hole has been cut by the auger to a fairly exact size, $5\frac{1}{2}$ litres of water will give the required depth. The time at which the water is poured into the hole and the time when the water level is seen to reach the bottom of the hole should be noted and the elapsed time expressed in minutes. Where practicable, the test should be repeated once or twice to get an average time.

On completion of this first group of tests, the hole should be bored for a further 1 m, to make it 2 m deep, and a second group of tests made, again using a 300 mm depth of water above the bottom of the hole. If necessary (as discussed below) the hole should be extended in about 1 m steps, and tests made at each depth.

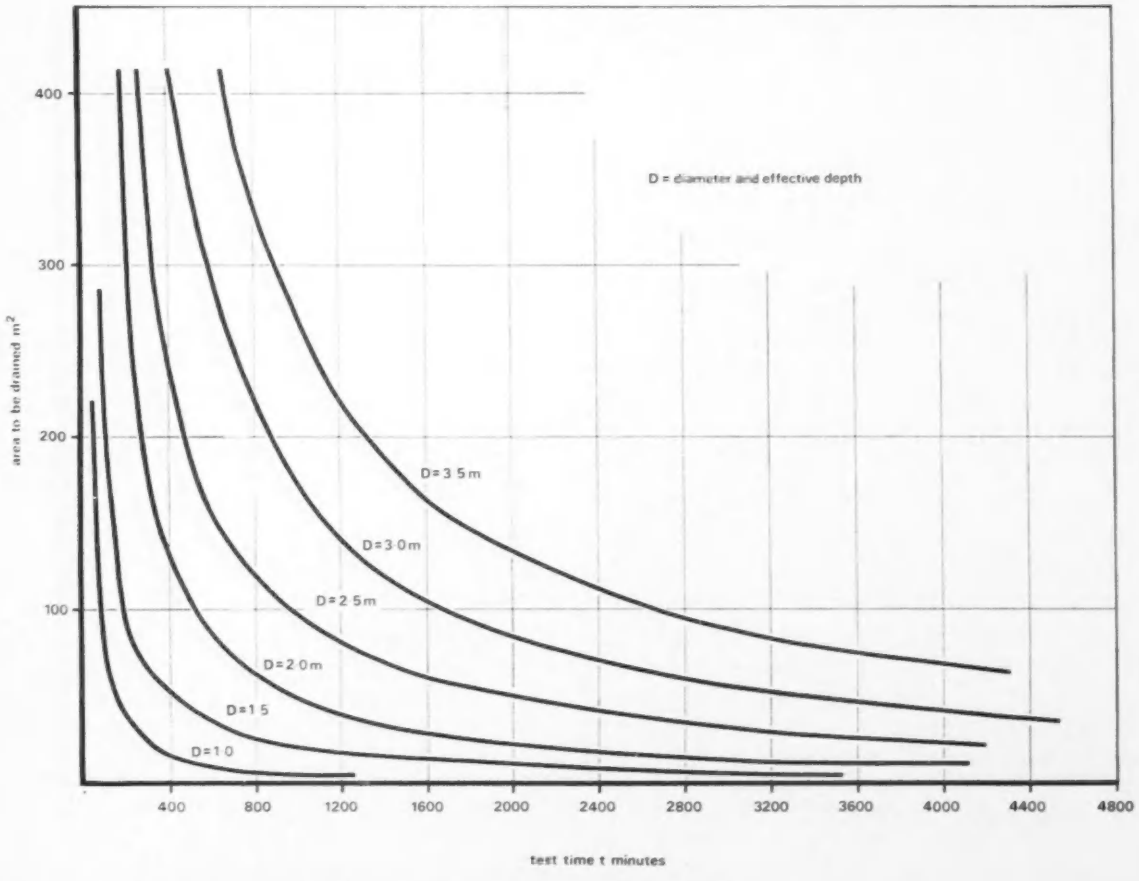


**Fig 1** Size of soakaway determined from permeability test time and drained area

### Design of soakaway

The rate of rainfall corresponding to a two-hour storm occurring on average not more than once in ten years is 15 mm/hour and this is the basis of the recommendations in this digest. On this basis, overflowing of a soakaway for as long as two hours is unlikely to occur more than once in ten years and this seems a reasonable risk to take. If a soakaway can accommodate the rate of rainfall in a two-hour storm, it will be able to accommodate the rate of rainfall in longer storms. Also, a soakaway designed for this two-hour storm rate will probably accept the higher rainfall from shorter storms if it is not already full of water; at worst, it might overflow for a period of not more than two hours.

It has been assumed that the soakaway will be cylindrical in shape and will have a diameter about the same as its effective depth, the depth below invert level. The relationship between the diameter (or effective depth) required for the soakaway to suit a give area of roof and/or paved area, and the time $t$ given by the tests, is shown by the curves in Fig 1. To use these curves, a vertical line is drawn upwards from the test time, $t$ minutes, and a horizontal line drawn from the area to be drained. To illustrate the method, if the test time $t$ was 880 minutes and the soakaway is required to take the water from a plan area of 103 $m^2$, the diameter (and depth) of the soakaway, from Fig 1, should be 2·5 metres.

If the ground is not very permeable, the size of soakaway can be kept down by splitting up the area to be drained into several parts, with a separate soakaway for each part. In the case of a small house, for example, the two sides of the roof and the paved driveway or yard could be drained to three separate soakaways.

Where the permeability of the ground increases with depth, tests in the deepened holes will give lower values of $t$, so that it may be cheaper to build a smaller soakaway at a greater depth below the surface.

### Construction

Soakaways can be constructed in two main forms, filled and unfilled, depending to some extent on their size.

For small soakaways, an excavated hole can be filled with a coarse granular material such as broken bricks, crushed sound rock, or river gravel with a size range of 150 mm to 10 mm, see Fig 2. The end of the inlet pipe should be surrounded by only the large pieces, to ensure that the rainwater can flow freely into the main mass of granular material. Above the pipe, the size of the pieces should be gradually reduced until the surface of the granular material, at about 0·5 m below ground surface, can be blinded to take a layer of topsoil. This topsoil covering can form a part of a garden or support a lawn.

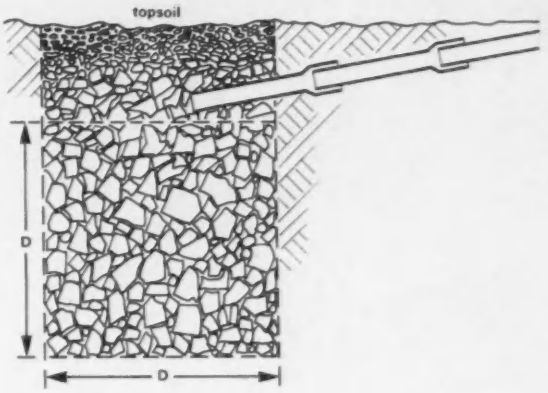


**Fig 2** Small filled soakaway

For larger soakaways, the excavated pit may be lined with brickwork laid dry, or with jointed honeycomb brickwork. Alternatively, they can be built with a rigid lining such as perforated precast concrete rings or segments, laid dry, surrounded by granular material to lead the water into the soil, see Fig 3. The top can be covered with a standard reinforced concrete manhole top to suit the rings or segments, fitted with an access cover so that it is possible to clean out accumulated silt and rubbish.

### Caution

Soakaways should be built on land lower than, or sloping away from, buildings and they must be kept at a safe distance from buildings. In land overlying chalk there may be a serious risk of swallow holes and these may be activated by the concentrated discharge from a soakaway. There have been cases of collapse of the corner of a building caused by a soakaway built too close to it, and an example of a swimming pool which lost one end into a swallow hole which developed under a soakaway built to take water from the pool itself. Because of the wide variations in soils and site conditions, it is not possible to give any generally applicable guidance as to the 'safe' distance from a building but the local authority can usually offer advice on this, based on their detailed knowledge and experience of the locality.

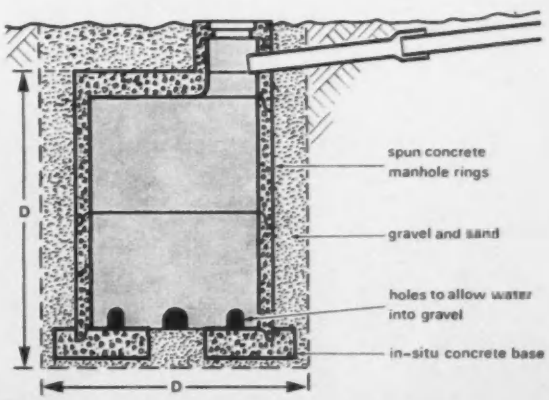


**Fig 3** Soakaway pit with rigid lining

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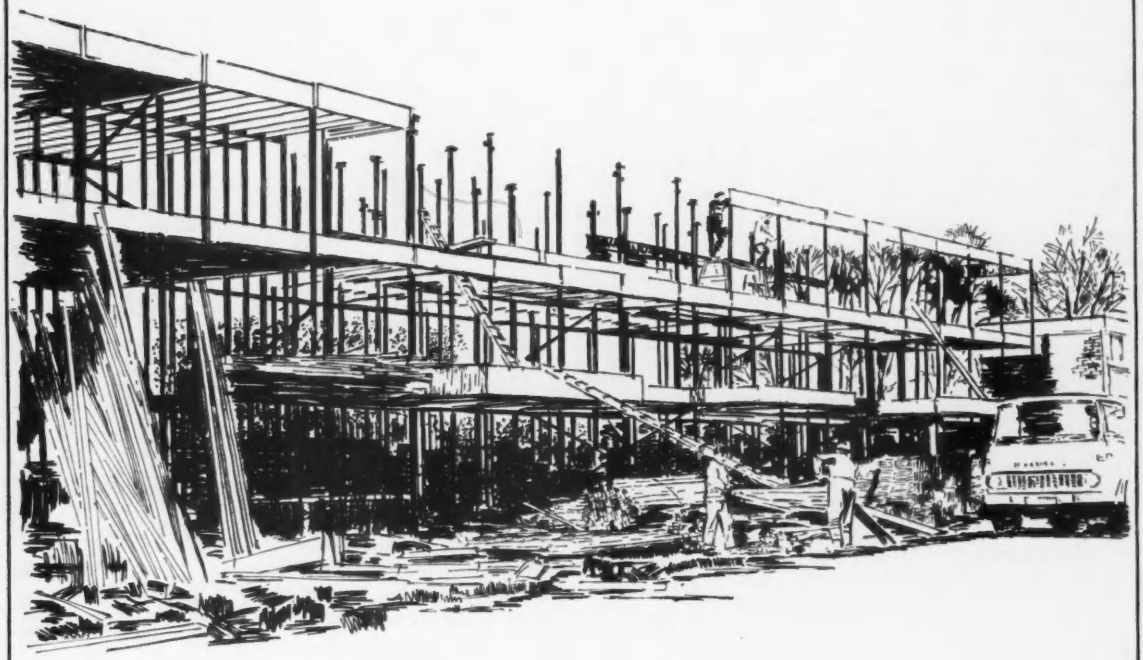

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